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PROPOSED MEASUREMENTS OF CRITICAL ANGLE AND TENSION OF AN AN/SQ--ETC(U)

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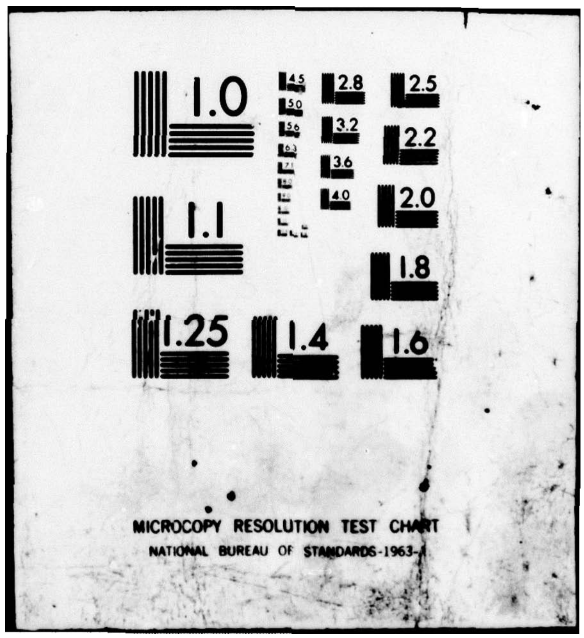
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FORT TRUMBULL, NEW LONDON, CONNECTICUT

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PROPOSED MEASUREMENTS OF CRITICAL ANGLE AND TENSION OF AN AN/SQA-10 FLEET-TYPE TOWLINE

By

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and
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INTRODUCTION

The trailing angle of a towline, ϕ, is the acute angle between the intersection of the towline and the direction of motion. This angle changes for every increment of towline length when the towline, with a towed body attached to the lower end, is trailed at constant speed. When a towline is trailed without a towed body, the angle ϕ is constant for every increment of towline length; therefore, the towline trails in a straignt line inclined to the stream and at a constant angle. This angle, which varies inversely with speed, is called the critical angle, ϕ_c.

This statement is true by neglecting weight of cable, not stated here DS 7/21

ϕ_c is required in towline prediction calculations. When the towline is trailed with a towed body, the trailing angle at the water surface approaches the critical angle, ϕ_c, as the length of towline is increased.

Many towline-drag calculations include only the drag normal to the towline and neglect tangential drag. When the critical angle, ϕ_c, is very small, the tension in a streamline towline may be due largely to tangential drag. This towline tension may be measured with a dynamometer.

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PURPOSE OF SEA TEST

The purpose of the sea test is to obtain experimental data on the AN/SQA-10 Fleet towline for performance predictions that will be applied to the development of VDS towlines. Data will be obtained by conducting towing tests of the AN/SQA-10 towline without the towed body.

OBJECTIVES OF TESTS

The objectives of the tests are:

a. To determine how the measured critical angles compare with the calculated values; and

b. To correlate towline tensions with the critical angles.

EQUIPMENT, INSTRUMENTATION, AND SERVICES

The following equipment, instrumentation, and services are required:

a. A ship with VDS towing capability, such as the USS MALOY (E-DE 791) or an AN/SQA-10 equipped ship;

b. A Fleet-type AN/SQA-10 towline (about 500 feet long), with sectional, complete fairing, without the towed body, with the mechanical end fitting at the drum end, and with no other end fittings;

c. A 10,000-lb.-capacity dynamometer, for installation on the fantail so as to indicate towline tensions;

d. The use of the ship's motor whaleboat from which a photographer can take photographs of the towline training angle, ϕ, while the ship passes by at various speeds;

e. The use of the ship's pitlog calibrated to an accuracy of 0.1 knot to indicate speed; and

f. VDS hoist operators and telephone talkers, as required.

METHOD OF CONDUCTING TESTS

An operations area large enough to enclose a square 20 miles on a side should be assigned. The 20-mile square should have a minimum depth of 100 fathoms of water. Towing tests are to be conducted only during daylight hours in sea state 1 or less. The ship is to maintain a straight course into or with the wind and pass by the whaleboat at a suitable distance (possible 100 feet) under the following towing conditions:

a. Cable payed-out: 300 feet
b. Ship speeds: 5, 10, 15, 20 knots
c. Towline kite angle: less than 5 degrees

Operations will be repeated for cable-payed-out lengths of 350, 400, 450, and 500 feet.

It is estimated that three days of operating time in sea states 0 to 1 will be required.

EXPECTED DATA AND RESULTS

Ship speed, cable payed out, and the angle ϕ_c (measured from the photograph to be taken), will be recorded as primary data. Data on existing sea conditions, such as sea state, wind speed, and direction, will be recorded.

From preliminary calculations, ϕ_c values are expected to be about as follows:

Speed	ϕ_c
5 knots	62 degrees
10 knots	35 degrees
15 knots	24 degrees
20 knots	18 degrees

Towline tensions will be recorded for each speed and cable-payed-out length.

Since 20 to about 125 feet of towline will lie in the ship 's wake, this condition will have to be taken into account when applying the test results to performance predictions. Because of the effect of the wake, it is expected that the tests will yield only rough results.

TWO POSSIBLE ADDITIONAL TESTS

It is expected that a towing test might be conducted with experimental anti-kiting trim tabs attached to the trailing edge of the fairing tailpiece at specific locations along the towline. The kiting angle will be measured before and after the attaching of trim tabs in order to determine how effectively the tabs reduce the tendency of a towline to kite to one side.

The velocity of the water past the towline is an important factor in drag calculations, since drag is a function of velocity squared. Usually the magnitude of velocity used is the speed read on the ship's pitlog. The DTMB knotmeter Mark II may be useful in obtaining a more accurate speed reading.

CONCLUSIONS

The critical angle, ϕ_c, is a required factor that must be known in towline performance predictions. One way of measuring ϕc is by conducting a towing test of a towline without the towed body.

Five days of sea time should be sufficient to complete all tests anticipated.

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